Northern Rhodesia.

Department of Agriculture

ANNUAL REPORT

for the year 1935.

Price: TWO SHILLINGS

IMPERIAL MYCOLOGICA
8 JUNE 1936
INSTITUTE

LUSAKA:
PRINTED BY THE GOVERNMENT PRINTER,
1936.

275m—U309 5-36

Northern Rhodesia.

Department of Agriculture.

ANNUAL REPORT

for the year

1935.

DEPARTMENT OF AGRICULTURE.

STAFF LIST, 1935.

Headquarters :

C. J. Lewin, M.C., B.Sc.	... ...	Director.
R. O. Burton	... ...	Clerk.

Agricultural Staff :

W. Allan, B.Sc., A.I.C.T.A.	... ...	Entomologist, Mazabuka.
U. J. Moffat, B.Sc., N.D.D.	... ...	Agricultural Officer, Abercorn.
R. H. Fraser, B.Sc., A.I.C.T.A.	...	Agricultural Officer, Fort Jameson.

Forestry Staff :

J. D. Martin, B.Sc.	... ...	Assistant Conservator of Forests, Livingstone.
C. E. Duff, M.A.	... ...	Assistant Conservator of Forests, Ndola.
R. G. Miller, B.Sc.	... ...	Assistant Conservator of Forests, Lusaka.
G. R. Martyn	... ...	Forester, Livingstone.

Loan Staff :

C. G. Trapnell, B.A.	... ...	Ecologist.
J. N. Clothier, Dip.Agric., A.I.C.T.A.		Agricultural Officer, Ecological Survey.

Empire Cotton Growing Corporation Staff :

A. G. Bebbington, M.Sc.	... ...	Cotton Officer, Mazabuka.
R. M. Fowke	... ...	Assistant to Cotton Officer.

Northern Rhodesia.

DEPARTMENT OF AGRICULTURE.

Annual Report for the year 1935.

AGRICULTURE IN THE TERRITORY.

But for a single unfortunate feature, the year 1935 would have been one of steady improvement for the farming industry. The development of sidelines proceeded satisfactorily, there were record crops of wheat and potatoes and ground was gained by coffee and tobacco planters. Unfortunately the maize crop, that mainstay of arable farming, was a very poor one.

2. The planting season opened slightly later than usual and operations were further delayed by heavy rains in December. Little effective rain fell after the second week of February, thus the season was a very short one. A new development in the locust situation aggravated what was already a sufficiently serious matter.

Maize.

3. There was a further increase in the maize acreage, particularly in the Lusaka and Chisamba districts, but the crop was everywhere a poor one. Severe locust damage was suffered by all districts except Chisamba. The crop was damaged at a particularly unfortunate stage, and any slight recovery which might otherwise have taken place, was prevented by the abnormally early onset of the dry weather.

4. MAIZE PRODUCTION.

	Kalomo.	*Mazabuka.*	*Lusaka.*	*Chisamba.*	*Fort Jameson.*	*Other Districts.*	*Total.*
1934-35—							
Acres planted ...	864	12,054	17,181	8,817	100	1,002	40,018
Yield in bags ...	2,079	53,345	43,979	58,039	564	2,368	160,374
Yield per acre ...	2.4	4.4	2.6	6.6	5.6	2.4	4.0
1933-34—							
Acres planted ...	875	11,810	15,077	7,033	450	1,242	36,487
Yield in bags ...	4,658	84,900	91,111	61,371	2,250	6,404	250,694
Yield per acre ...	5.3	7.2	6.0	8.7	5.0	5.2	6.9
Increase (+) or Decrease (—) in 1934-35—							
Acres planted ...	—11	+244	+2,104	+1,784	—350	—240	+3,531
Yield in bags ...	—2,579	—31,555	—47,132	—3,332	—1,686	—4,036	—90,320
Yield per acre ...	—2.9	—2.8	—3.4	—2.1	+0.6	—2.8	—2.9

5. 132,000 bags of farm grown grain were offered for sale, but as there was a large carry-over from the previous season, supplies are still more than ample. Little new native grain came on the market, but village granaries were still stocked from the former harvest, and considerable quantities of old grain were traded.

6. In all normal years the Territory is now likely to be more than self supporting in maize and, if uneconomic export is to be avoided, there must be some reduction in acreage. Probably through the wider adoption of the practice of green manuring, yields are definitely increasing. During the period 1919-1930 the average yield was 4.6 bags per acre. In spite of severe locust damage it was 5.2 bags from 1931 to 1935, it is likely to reach 6 bags per acre when the locust menace has passed.

7. In the absence of unexpected developments it is doubtful whether there will be a local market for more than about 160,000 bags of farm grown grain plus 60,000 bags for farm consumption. It would therefore be wise if perhaps the aggregate area under maize were restricted to some 37,000 acres until there is marked expansion in internal demand.

Tobacco : Fort Jameson.

8. Climatic conditions were almost ideal at Fort Jameson until February, when a prolonged drought followed by heavy rain affected the later portion of the tobacco crop. Some particularly good leaf was produced in the earlier part of the season. Production of flue cured tobacco increased slightly, but there was a further decline in the sun cured type which was formerly grown on a fairly extensive scale in the Luangwa Valley.

9. Sales were reasonably satisfactory and, on the whole, the planters experienced their best year since the boom. During the last few years the district has slowly but surely recovered from the most severe depression which has ever afflicted an agricultural industry in Northern Rhodesia. In this it has been materially assisted by the agreements under which a portion of the crop is sold in the Union and Southern Rhodesia. If further advance is to be made it must come through expansion of sales in the United Kingdom, for the outlet in Africa, though remunerative, is strictly limited.

10. For some years past almost double the quantity of Northern Rhodesian tobacco has been sold in or from the United Kingdom than has been imported, and the dead weight of accumulated stocks is now lifted. Moreover transport charges have been reduced considerably. The Lusaka route was used for part of the crop during the last season and proved to be cheaper than the former outlet via Nyasaland and Beira. These two factors should help the industryto re-establish itself in the home market.

11. Even if there were a ready market for them, transport and marketing costs would still make it impossible to export low grades at a profit. A planter cannot grow only the high grades of tobacco, but a good deal of expense could be saved by more discriminate harvesting, whereby inferior leaf is discarded in the field and the expense of curing and grading is limited, as far as possible, to grades which will be saleable. Very selective harvesting has been practised with conspicuous success on a few estates during the past year. From these estates the quantity of unsaleable leaf was negligible, but, taking the district as a whole, it is estimated that almost a quarter of the *cured* crop had to be discarded.

Tobacco : Railway Belt.

12. Production declined considerably in the railway belt, but I am assured that there would be a revival of interest if competent advice were more readily obtainable. Unfortunately it is by no means certain that experience under Fort Jameson conditions is necessarily applicable to this area. The department at its present strength can do little or nothing to help, and the cost of a tobacco station for the railway belt would be prohibitive. An alternative scheme has been suggested and is at present under consideration.

13. VIRGINIA TOBACCO PRODUCTION (FLUE CURED).

	Railway Belt.	*Fort Jameson.*	*Total.*
1934-35—			
Acres planted	160	3,218	3,378
Yield in pounds	76,000	1,480,000	1,556,000
Yield per acre	475	460	461
1933-34—			
Acres planted	357	2,916	3,273
Yield in pounds	180,000	1,320,000	1,500,000
Yield per acre	504	450	459
Increase (+) *or Decrease* (—) *in* 1934-35—			
Acres planted	—197	+302	+105
Yield in pounds	—104,000	+160,000	+56,000
Yield per acre	—29	+10	+2

Wheat.

14. Thanks to a severe winter, rust was not prevalent and the wheat crop was a record one both in point of size and in yield per acre. About 3,000 acres were planted in the Lusaka district and 200 elsewhere. The total yield was over 18,000 bags of which 17,000 were offered for sale. The demand for wheat is likely to exceed the supply for some time to come, and the crop yields better in Northern Rhodesia than in most parts of Africa. Though the more fertile soils of the Railway Belt are not well endowed with irrigation possibilities, the irrigated acreage can and probably will be extended fairly considerably within the next few years.

Groundnuts.

15. Groundnuts have declined in popularity as a settlers' crop mainly because of the very low yields which have been obtained recently. During the last three years the rains have stopped in February and this may partly account for the decline in yield, but the crop would probably do a good deal better on lighter soils than those normally farmed in the maize belt. Both groundnuts and beans (cow-peas) are imported in considerable quantities, and it is intended to attempt to stimulate the production of these crops by natives.

Potatoes.

16. Potato production has doubled since 1930 and now amounts to some 5,500 bags of which 1,000 bags are retained for farm consumption. There is now little room for expansion in main crop potatoes, but the Territory is largely dependent on importations from the south for its requirements from August till March.

Coffee.

17. With the exception of two estates at Fort Jameson, one of which is in production, coffee growing is confined to the Abercorn district. Here some reduction of productive acreage occurred through abandonment, but this is an indication not of loss of confidence, for the outlook is as promising as it ever was, but of the growing realisation that the earlier planting and cultural methods were unsuited to local conditions. The older coffee will require some time and attention before it fully recovers from its early treatment, and it may even prove profitable to abandon some of these fields gradually. The condition of the younger plantations, all of which have been established in accordance with Mr. Moffat's methods, is uniformly satisfactory.

18. The present position of estates at Abercorn is as follows :

Coffee in bearing	200 acres.
Coffee not bearing	214 ,,
Coffee planted in the 1935-36 season	55 ,,
	469 acres.

The total production in 1935 was 550 cwt. Most of this was disposed of by private sale at satisfactory prices, very little entered the open market. Steps have now been taken to sell roasted and ground Abercorn coffee in Northern Rhodesia.

19. Most of the coffee is irrigated and anti-erosion measures, composting, mulching and borer control are now routine practices. *Tephrosia* has now been adopted as a temporary shelter for young coffee.

The Red Locust (*Nomadacris septemfasciata*).

20. The return migration of what is believed to be the eighth generation of the present red locust cycle developed in a very singular way during the later months of 1934 and the earlier part of 1935. Two distinct waves of invasion can be differentiated. The first was an enormous influx from the north and west which came to an end in November. This movement was described in the report for 1934. Late in the year there began a second invasion by huge swarms, not fully gravid, which came from the south-east, the west and the north. Even as late as March swarms which were still laying continued to enter the Territory.

21. The explanation of this prolonged return migration is probably to be found in the extension of the range of the locust over a great part of Africa, and in variations of the breeding period in different areas. The swarms of the second invasion doubtless originated in areas much more distant than those of the first.

22. The invading swarms from the south-east, which entered in late December, 1934, moved to the north-west on a front of more than 150 miles and caused considerable damage on farms from Monze southward. Early in January these swarms had broken up, but the small loose groups which remained were a source of much trouble. On many farms such groups of fliers remained for several weeks, dying off slowly, but in the meantime feeding on the young maize from which it was practically impossible to dislodge them.

23. While the invasion from the south-east was taking place, enormous swarms were crossing the border from Angola into Barotseland. During January this great mass of locusts, which apparently covered an area with a front of 60 or 70 miles and a depth of nearly 300 miles, moved eastward across North-Western Rhodesia at a mean rate of some 15 miles a day. The swarms reached the farms west of the railway line on about the 21st of January, and many farms in the Mazabuka and Lusaka districts were more or less seriously affected by the movement. Early in February the attenuated and diseased remnants of these swarms disappeared into the Zambesi Valley.

24. In March large and heavily gravid swarms from Angola and the Congo crossed Mwinilunga district and entered the Solwezi district, but throughout the remainder of the Territory fliers had disappeared or only small groups of diseased stragglers remained.

25. Practically the whole of the European farming area south of Chisamba was affected either by the movement from the south-east or by that from the west. In the track of the three main invasions of the second period, that is, throughout most of the Southern Province, in parts of Barotseland and in the north-west of the Central Province, native crops suffered considerably.

26. Compared with the enormous scale of the return migration, hopper hatchings were astonishingly small. The fungus disease, *Empusa grylli*, had been very active among the parent swarms, and in February a hitherto unrecorded disease was discovered. This was caused by a green muscardine fungus *Metarrhizium anisopliae*. It seems probable that a large proportion of the parent swarms was destroyed before egg-laying had been completed. Eggs were heavily parasitised, and over large areas where considerable egg-deposits were known to exist no hatchings occurred. Further, disease became general among the hoppers during January, and in every district the bands were greatly reduced while in many areas they were completely annihilated. Consequently the damage caused by hoppers was very slight and, though spraying was continued on some farms where disease was less rapid in its action, in most cases resort to artificial methods of control was unnecessary.

27. The young swarms of the ninth generation, which began to mature in March, were smaller and less numerous even than those of the previous year. During the winter and spring months the usual dispersal migration of these young swarms took place towards the west and north-west.

28. It was not until November that a movement corresponding to the return migration of previous years was recorded. During the second week of the month eastward moving swarms, few in number but some of very large size, passed through the farming districts between Lusaka and Pemba. These swarms were moving very rapidly, they were not gravid, and by the middle of November the migration had come to an abrupt end. During December the Territory was practically free of swarms and neither egg-laying nor hopper emergence was reported.

29. This spectacular and very welcome diminution of the red locust outbreak is probably to be attributed mainly to the spread of disease and parasitism throughout practically the whole range of the locust. Previously epidemics had been local, but with the eighth generation disease spread and became general. It seems probable, at least as far as Northern Rhodesia is concerned, that the peak of the red locust outbreak has been passed, but the menace has not necessarily vanished entirely.

The Tropical Migratory Locust.

30. Swarms of the tropical migratory locust were rare and this species did not constitute a serious danger. The few swarms recorded were confined to parts of Barotseland and to the west of the Northern Province. In these areas breeding occurred on a small scale.

The Agricultural Advisory Board.

31. His Excellency inaugurated the Agricultural Advisory Board in March. This body, on which almost all interests are represented, has already proved invaluable as a tribunal before which the problems and demands of the agricultural industry are sifted impartially. The action taken on its recommendations has been extremely prompt. The unquestioned success of the Board is due in no small degree to the ability and personality of its chairman, the Treasurer.

32. On the arable farming side, the Board at its first meeting appointed a sub-committee to investigate the marketing of maize. This committee, after carefully examining all possible alternatives, was reluctantly forced to the conclusion that in the interest of the European and native producers, and, indeed, in the general interest, the introduction of a form of maize control would be necessary. Its report was adopted by the Board with a few minor amendments, and was later accepted by Government. A further sub-committee was then appointed to examine the imports of agricultural commodities which could be produced in the Territory. This committee had not completed its report by the end of the year.

33. As chairman of these two sub-committees, I would like to record my appreciation of the very real assistance given by the Farmers' Associations, traders and the general public in the production of evidence. In particular, it would not have been possible to present a unanimous report on maize control had not the farming bodies reached agreement between themselves.

Work of the Department.

34. 1935 was a year of steady if unspectacular progress. The financial stringency, which has fettered the work of the department for some years, was eased slightly and permitted expansion in two important directions, cotton trials in native areas and a new station for native agriculture near Abercorn, but just as the restriction of departmental activities did not immediately render the department non-productive, there will be an inevitable lag between expansion and its results. The department rapidly recovered from the disorganisation caused by retrenchment, and during the last two years has consolidated itself in a restricted but useful programme adapted to the financial circumstances. It is now breaking new ground in accordance with an elastic programme of development.

Forestry.

35. Forestry continued to be administered as a sub-department. The year's work is recorded at length in Part II of this report.

The Ecological Survey.

36. The Ecological Survey did not resume field operations during the year. Its staff was absent on leave during the earlier months and was then engaged in writing the report on North-Western Rhodesia. Most unfortunately the Ecologist was temporarily invalided before this task was completed. An interim report on the suitability of unalienated Crown land for European and native occupation was submitted.

37. Mr. Clothier, the Agricultural Officer of the Survey, was posted as a relief at the Fort Jameson station and is undertaking an investigation of the native reserves in that area. Local overcrowding and soil erosion are becoming serious in these reserves, but it was considered advisable to obtain a complete picture of the situation before deciding on a programme of action.

Conferences and Publications.

38. The two Rhodesias and Nyasaland held two inter-state conferences on agricultural matters at Salisbury during the year. The first of these took place in April and was attended by representatives of the tobacco interests of the three Territories. Its primary object was to prepare a joint statement for presentation to the Imperial Economic Committee on Empire Tobacco, but it was also unanimously agreed to recommend to the three Governments that legislation be introduced to restrict exports to the United Kingdom to the visible and reasonably anticipated demand. The resolutions of the conference were later accepted by the three Governments. The Northern Rhodesian representatives were the Hon. J. L. Bruce, Mr. T. Page and myself.

39. In December a second inter-state conference was convened to consider the co-ordination of research work of technical departments. It was attended by the Directors of Medical and Veterinary Services and myself. The opportunity was taken of comparing and, as far as possible, of co-ordinating the draft tobacco legislation of the three Territories.

40. While on leave Messrs. Allan and Bebbington attended the fourth Imperial Entomological Conference and read a joint paper entitled " Control of Cotton Stainers ". They also attended the third Imperial Botanical Conference and presented a paper by Mr. Trapnell on " Ecological Methods in the study of Native Agriculture in Northern Rhodesia ".

41. It was not possible to publish a departmental bulletin during the year. The following papers were published in the Proceedings of the Inter-State Locust Conference, Pretoria, 1934 :

" The Swarming of the Red Locust in Northern Rhodesia," by W. Allan.

" The Occurrence of the Tropical Migratory Locust in Northern Rhodesia," by W. Allan.

THE MAZABUKA STATION.

42. This, formerly the chief experimental station, has now become the headquarters of the administrative and specialist staffs and a centre from which cotton trials in native areas are directed. Formal experimentation at Mazabuka was restricted to cotton investigations which were financed entirely by a generous grant from the Empire Cotton Growing Corporation.

Pastures.

43. Observations on the grass plots were continued. These are now in their third year. After a promising start the Commercial Rhodes Grass plot has steadily deteriorated ; growth is no longer luxuriant, and the grass has not proved sufficiently aggressive to suppress weeds. On the other hand, the indigenous Kafue Rhodes Grass strain has done very well. It is late in maturing, and unlike the ordinary veld, produces an excellent crop of hay at a time when hay-making can be done safely. Herringbone Grass (*Urochloa pullulans*) is essentially a pasture grass. It seeds itself satisfactorily and has increased in density after a rather disappointing start. It is perhaps the most winter-palatable and nutritious of all indigenous species and would appear to provide a satisfactory bottom grass to increase the aftermath of Kafue Rhodes Grass meadows. Unfortunately, with its tufted habit it is not very suitable for culture in pure stands.

Cotton at Mazabuka.

44. A trial of eight strains of U.4 failed to give significant results. A spacing trial was also inconclusive. In marked contrast to the previous season, the incidence of American Bollworm was very light and trap cropping experiments showed that there were no definite peaks of oviposition on maize, sorghums or groundnuts. Routine observations of stainer populations on cotton and wild host plants confirmed the results of former trials. These are, briefly, that in the *Acacia* savannah cotton forms a link in the sequence of host plants of *Dysdercus superstitiosus* and consequently is heavily infested by populations wandering in search of food during the interval between the flowering of the early and late species of wild hosts. The incidence of *D. fasciatus* was again shown to be dependent on the general condition of the wild host *Thespesia rogersii*. This host carried only a very small crop of fruit in the 1933-34 season and, in addition, was severely defoliated by locusts. Consequently the population of *D. fasciatus* which survived the dry season was small and this was reflected by a later and reduced influx on cotton in the following year.

Cotton in Native Areas.

45. In the last report it was explained that the logical development of the cotton work at Mazabuka lay in extending the trials to bush types other than the *Acacia* savannah which, in effect, involves trials in native areas, for European farming is almost exclusively confined to the latter type of country. It was also stated that at the then ruling prices it appeared that cotton might be more attractive than maize to the peasant farmer.

46. Following the promising results obtained from small plots in the Namwala district in 1934, the trials were extended to a much wider range of country. Their ultimate objective is to ascertain if and where a native cotton growing industry can be developed, their immediate aim was to test an hypothesis formulated by Messrs. Allan and Bebbington concerning the inter-relationship of cotton, wild host plants and stainer populations.

47. The plots were sited on native farms near Pemba, Namwala, Mumbwa and Kalomo and were selected to give the maximum amount of information on the behaviour of cotton stainers. Unfortunately it so happened that they could not have been better chosen had the object been to expose them to the heaviest possible locust damage. The Kalomo plots were completely ruined and were abandoned ; elsewhere the number of plots was considerably reduced and those which survived were more or less seriously damaged. In addition, the initial stands were generally poor as a result of unfavourable planting conditions, and the abnormally early onset of the dry season taxed the locust damaged plants severely. In spite of these disastrous conditions fairly satisfactory yields were obtained where little stainer damage had been expected, and the records of stainer incidence not only threw fresh light on the problem, but substantiated the theory which had already been developed.

48. Two species of stainer, *Dysdercus superstitiosus* and *D. fasciatus*, have so far proved of importance in North-Western Rhodesia. In the *Acacia* savannah (sweet bush) to which European farming is largely confined, cotton is generally severely attacked by both species. *D. superstitiosus* appears early in the crop and *D. fasciatus* somewhat later, but from flowering onwards there is usually a high stainer population in the field, one or other species predominating at different times. The host sequence of the two species has been worked out at Mazabuka and it was found that, while *D. superstitiosus* can breed on a large number of annual hosts, *D. fasciatus* is dependent on a single perennial host, the tree *Thespesia rogersii*.

49. The siting of the experimental cotton plots in native areas was based on the distribution of *Thespesia rogersii*, and it was assumed that in regions where this host is rare or absent the attack of *D. fasciatus* would be slight. The results support this assumption, but in addition it was found that on plots not in or near country of the *Acacia* savannah type, the attack of *D. superstitiosus* was also slight. The records of stainer incidence indicate clearly the reason for this comparative immunity, but in order that this may be understood it is necessary to review the conditions which bring about the heavy infestation of cotton in the *Acacia* savannah.

50. During the late dry season *D. superstitiosus* is apparently absent from this type of country, but shortly after the first rains a wandering population appears. For over a month this population survives on various plants, then *Hibiscus trionum*, a small short lived annual, comes into flower and a generation is bred up on this host. In February *H. trionum* dries up and dies, but the next host in the sequence does not flower until late March. Cotton very conveniently fills this gap in the food cycle, and consequently a heavy invasion of the crop is inevitable in the *Acacia* savannah.

51. In other types of country it was found that where the incidence of *D. superstitiosus* on the cotton plots was slight, there existed an abundance of hosts which flowered before cotton. These diverted the attack from the crop and held the stainer population over the critical period.

52. One material advance in the knowledge of the sequence of *D. superstitiosus* was made at the end of the year, when the pest was discovered on an entirely new and unsuspected host (*Triumfetta sp.*) during the months of October and November. The importance of this discovery lies in the fact that previously we had never been able to find either adults or nymphs of *D. superstitiosus* at the end of the dry season, and the origin of the population which appeared with the early rains was a complete mystery. Conditions during October and November appeared to be actually lethal to the species, for it was impossible to maintain a population in the insectary, except under artificially high humidity. The foci discovered consisted of dambo margins covered with a thick growth of coppice *Combretum* which

provided dense shade. In this was an abundance of *Triumfetta* on which the stainer lived and bred freely. Feeding took place in the early morning and evening ; during the heat of the day the entire population sought shelter on the undersides of leaves in dense shade.

53. The results obtained from the trial plots in each area are briefly summarised in the following notes. Yields are given in terms of seed cotton.

Pemba.—Of the six plots selected, two were completely destroyed by locusts and two were failures owing to lack of cultivation and late planting. The surviving plots were both damaged by locusts, one comparatively slightly and the other fairly severely. They yielded a clean crop at the rate of 250 and 180 lbs. per acre respectively. The attack of *D. superstitiosus* was very slight although a large population of the stainer appeared on an early flowering strain of *Hibiscus asper*(?). *Thespesia rogersii* occurs in the neighbourhood but much less commonly than within the *Acacia* savannah. The expected attack of *D. fasciatus* developed, but the species was not abundant on cotton until late in the season and the damage was slight.

Namwala.—Four plots were planted in the district, but one was badly damaged by locusts and another, owing to very late planting, was a failure. The remaining plots were at the Boma and at Chikupi's village. The Chikupi plot was situated in country similar to that at Mazabuka and, as was expected, heavy attacks of both stainers were experienced and the crop was severely stained. In the country surrounding the Boma the host sequence is such as to favour an attack of *D. superstitiosus* on cotton. This species did appear in the plot in some numbers. *Thespesia rogersii* is absent over a considerable area in the neighbourhood and consequently *D. fasciatus* did not put in an appearance until very late in the season and then only in negligible numbers. This plot yielded at the rate of 300 lbs. to the acre. The very severe locust damage to a plot sited on the Kalahari sands unfortunately precluded any estimate of yield, but no stainers appeared on the plot and about half the surviving plants carried between 60 and 70 clean bolls to maturity.

Mumbwa.—Five plots were established within a radius of 16 miles of Mumbwa Boma but two were destroyed and two severely damaged by locusts. The cotton at the Boma was only very slightly damaged by locusts but this plot was intended as a control, the surrounding country being of the type in which heavy stainer attack is to be expected. The results were comparable with those obtained at Mazabuka, and although the plants were well-grown and the stand good, the plot yielded at the rate of only 120 lbs. to the acre. The two remaining plots were some 10 and 15 miles respectively from the Boma and were situated in the " Mutondo " bush. Here *Hibiscus vitifolius* occurs in quantity close to the gardens, and *Thespesia rogersii* is comparatively rare. A very large population of *D. superstitiosus* developed on the *Hibiscus* but the stainers appeared on cotton only in small numbers, while the attack of *D. fasciatus* was comparatively slight. One of these plots, badly damaged by the combined effects of locusts and drought and with a stand of only 40 per cent., yielded clean seed cotton at a rate of 200 lbs. per acre. The other, more severely damaged and partly on newly broken soil, gave a yield of 100 lbs. per acre.

54. These initial results, obtained under such adverse conditions, are certainly sufficiently encouraging to justify repetition and expansion of the experiment. A further pleasing feature is a change in the attitude of the natives within the trial areas from opposition and suspicion to interest and willingness to co-operate. This change is particularly noticeable in the Pemba area where many farmers applied for seed in the present season. Here 30 growers have been chosen from among the applicants. The trials are being repeated, also on a larger scale, in the Namwala, Mumbwa and Kalomo districts, and two new areas in the Livingstone and Mongu-Lealui districts have been added.

THE ABERCORN STATIONS.

55. At the coffee station progress in the discovery of cultural methods suited to the district has already been so rapid that there will be little more to report until results are obtained from the manurial trials.

The White Borer (Anthores leuconotus).

56. The life history under local conditions of this, the only serious pest at present, has now been worked out in some detail. Males and females emerge in approximately equal numbers between October and January. As a rule over 90 per cent. appear within the four weeks following the middle of November. They feed on the bark of coffee bushes after emergence, and by the end of March the majority have died. In cages copulation takes place periodically from emergence to egg-laying, after which females usually avoid the males. Egg-laying begins four weeks after emergence and continues until death. Up to 26 eggs are laid by each female ; usually only one is laid per day and one per tree. The eggs are normally laid in the bottom four inches of the stem. Occasionally they are laid as high as eighteen inches from the base but, if so, a fork in the stem is selected. Egg laying takes place in the early morning or late afternoon. The female cuts a slit in the bark in which the egg is laid deeply. The slit heals with a characteristic scar and vigorous rubbing is usually insufficient to dislodge or crush the egg. The normal incubation period is from twenty to thirty days, and all the eggs are usually hatched before the end of March. The young larvae tunnel spirally in the bark. During this period (February, March and April) the layer of bark covering the tunnels is easily broken down by rubbing, and the larvae can be found and extracted without difficulty. The feeding period in the bark above ground level lasts from six to ten weeks. Thereafter the larvae migrate downwards and enter the tap root, usually at a branch, from one to eleven inches beneath ground level. They tunnel upwards inside the root, periodically emerging from the tunnel at the point of original entrance to feed on the soft outer tissues of the taproot and laterals. These roots are frequently ring barked and during this period, which lasts for about 18 months, it is very difficult to extract borers. Pupation occurs early in October and the mature beetles emerge from exits made at the top of the tunnels. Preliminary observations on flight suggest that the adults do not travel far if conditions for egg laying are suitable in their immediate vicinity.

57. Control is effective if hand picking of adults is practised conscientiously between November and February, and if hand rubbing of stems and extraction of small larvae is performed twice or thrice between February and April. Once a larva has established itself inthe taproot the tree yellows, fails to ripen its crop, and die-back begins. Such trees should be uprooted and the larvae destroyed. The vacant space may often be replanted successfully.

58. The White Borer has been the cause of decline of more than one coffee growing industry, and it would certainly have killed the hopes of the Abercorn planters had they not been quick to adopt the control methods suggested.

Compost.

59. The routine manufacture of compost by an adaptation of the " Indore " process was continued throughout the year. 180 tons were made from the night droppings of ten head of cattle, at an average cost of 3*s*. per ton.

60. The encroachment of tsetse fly on certain estates has been followed by loss of cattle, and on these compost making has become difficult. Mr. Swynnerton, Director of Tsetse Research, Tanganyika Territory, did a rapid survey of the area during the year, and his reports indicate that control of fly may be possible at no great cost.

Manurial Experiment.

61. The block of coffee to be devoted to manurial trials is now three years old and it was given its first treatment in 1935. Already it is evident that the plots receiving 10 tons of compost per acre are growing more vigorously and are of a better colour than those from which compost has been withheld.

The Native Agricultural Station.

62. In past reports the need for serious work on the " chitemene " system and its alternatives has been stressed. The hope that a small station would be established to deal with this vital problem has been long deferred, but at length it has been realised. The " chitemene " (tree lopping) system of agriculture is practised with variations in many parts of the Territory, but it is the general system on the poor soils of the north-eastern plateau where " male " (*Eleusine coracana*) is the staple crop. Where the population is thinly dispersed and where abundance of trees exist, the system is comparatively innocuous. Where, however,

the population is concentrated in areas containing a limited reservoir of trees its effects are disastrous, for the trees are never given time to recover from one lopping before they are cut again, and rapid deforestation and its attendant evils result. This stage has already been reached in certain reserves in the Abercorn district. Whatever view may be taken of the " chitemene " system, it is unquestionably a very primitive and wasteful form of agriculture which renders the social and economic advancement of its adherents almost impossible, for villages must be small and scattered and constantly on the move to " follow the trees ". Nevertheless it is a safe and easy method on poor soils and its appeal to that non-agrarian people, the Awemba, is quite understandable. It will not readily be relinquished, but it is essential that an attempt be made, while there is yet time, to modify or replace it with something better. To tamper with a traditional agricultural system is a delicate and often dangerous matter, and unless an administration is absolutely sure of its ground it would be well advised to leave well alone. The object of the new station is to provide the administration with reliable information on the possibility of introducing a gradual change in the system.

63. By fortunate chance there is a tongue of vacant Crown land some fifteen miles south of Abercorn, which is readily accessible to the reserves in which deforestation is most serious. The station has been established here and will devote the next three years to confirming the tentative conclusions formed as a result of Mr. Moffat's careful observations on native agriculture. If, at the end of that time, it is thought that we have something definite to offer, a few villages will be allowed to enter on condition that they farm in accordance with simple instructions which will by then have been formulated. There is every reason to suppose that several villages would gladly accept this opportunity of migration. If the simple rules are found irksome or impracticable the villages will be free to return to the reserves. If it is found that they welcome occupancy under a measure of agricultural discipline, the whole area will be thrown open under similar conditions. By this means the soundness of any innovation will be thoroughly tested by that best of criteria " Will the native take it up ? ", before any attempt is made to guide or interfere with agricultural methods in the reserves themselves. If the scheme fails it will have done no harm ; if it succeeds its effect will be indeed far reaching. It is at least an honest and cautious attempt to deal with a very difficult and vitally important problem.

64. During the next three years the work of the station will be concentrated on two main objects. The first is to ascertain if and how dambo fringes can be cultivated permanently or semi-permanently. There is an abundance of such land in the existing reserves and it is considerably more fertile than that of the surrounding woodlands. Dambo fringes are cultivated by the Mambwe but not yet by the Awemba.

65. The second object is to ascertain if by slight modification of the " chitemene " system, more than one crop of " male " can be grown from a single burning in the woodlands. We have already had some indication that this is possible, but it is essential that the former trials, which could not be adequately supervised, should be repeated under more satisfactory conditions.

66. It is certain that the cultivation of woodlands under the " chitemene " system will die hard. It is hoped that the adoption of permanent cultivation of dambo fringes will reduce the amount of tree lopping, but tree lopping will never be entirely eliminated. It is therefore essential that an attempt should also be made to modify the " chitemene " system itself. If a method can be devised which will give but one extra crop of " male " per burning, its adoption would be equivalent to doubling the forested area of the reserves.

THE FORT JAMESON STATION.

67. Work at Fort Jameson was confined to tobacco and to a survey of the agricultural problems of native reserves. The latter survey is still in progress.

Variety Trial.

68. No significant differences in yield were obtained from a trial of *White Stem Orinoco, Yellow Mammoth* and *Amarelo. White Stem Orinoco* is now the standard variety of the district and has yielded consistently well for four successive years. It is reported to suit the requirements of the British market as it is neutral in flavour and rich in oils. *Yellow Mammoth* is popular with some growers, but

until it has proved itself markedly superior to *White Stem Orinoco* it would probably be better if planters concentrated as far as possible on the latter, if only for the sake of uniformity. *Amarelo* gave the heaviest yield of the three varieties though the difference was not significant. It is very easily cured and the leaf has an attractive appearance. Unfortunately it has a pronounced and distinctive aroma which renders it unsuitable as a flue cured variety, and planters have been urged to give it up.

Rotation Trials.

69. The rotation trials, designed to give information on the effect of varying frequencies of green manuring on the quality and yield of tobacco, have now completed their first cycle, and it should be possible to publish some fairly definite conclusions at the end of the present season.

Seed Selection.

70. A pure line selection of *White Stem Orinoco* promises well, and is now being tested against local and imported seed of the same variety. 15 lbs. of seed, mainly of *White Stem Orinoco,* was selected and sold to planters, and a further 27 lbs. of planters' seed was blown and disinfected. This service is becoming increasingly popular.

71. As at Abercorn, there can be no doubt that the station, in its brief five years of existence, has had a remarkable influence on estate practice. Contour ridging is being adopted by more and more planters every year, and green manuring has increased from 20 acres in 1930 to over 700 in 1935. The latter is now roughly one-fifth of the area under tobacco. Much yet remains to be learnt about the effect of green manuring on the tobacco crop, but the rotation tentatively suggested —Tobacco : Tobacco : Sunnhemp : Maize—has so far proved very satisfactory and has certainly appealed to planters as a great advance on their former practice.

Tobacco Enquiry.

72. While on leave, Mr. Fraser undertook an enquiry into the marketing of Northern Rhodesian tobacco in the United Kingdom. His report was a most useful one and has helped to clear up several points on which former information was conflicting. At one stage in his enquiry the evidence appeared hopelessly contradictory, but it then became clear that where adverse reports on Northern Rhodesian tobacco had been received, they came, in all instances, from brokers and manufacturers who had not handled the crop since 1930. Those who had dealt with more recent consignments were favourably impressed. Stocks of sound Northern Rhodesian leaf are now very low indeed, and much of the 1935 crop was barely a week in bond before being sold.

73. From Mr. Fraser's report it is evident that it is a mere waste of money to send inferior grades to England. He was able to give some indication of the lower limits, and found that there is a particular demand for long orange wrapper leaf and for a brightish mottled tobacco which is apparently peculiar to the Fort Jameson district. In the matter of packing it is recommended that " Lemon Brights " should be packed in 800 lb. hogsheads but that 200 lb. bales are satisfactory for the balance of the crop.

REVENUE AND EXPENDITURE.

74. The expenditure of the department, exclusive of Forestry and the Ecological Survey, has been roughly as follows in recent years :

	1930-31.	1931-32.	1932-33.	1933(*a*).	1934.	1935.
Administrative and Clerical	£4,000	£3,800	£3,300	£2,100	£1,500	£1,500
European officers employed	6	6	6	3	2	2
Field Work	£15,400	£17,000	£14,300	£7,400	£3,000	£4,000
European officers employed	14	15	14	11	3	3
Total	£19,400	£20,800	£17,600	£9,500	£4,500	£5,500
Total European officers employed	20	21	20	14	5	5

(*a*) Estimate based on whole year.

75. In this table the whole of the administrative costs have been charged to the agricultural branch of the department. In the last report it was explained that the drastic reduction in staff and expenditure did not occur in 1934, as the table would indicate, but had been completed before the end of 1933.

76. Revenue from this department is naturally small. In 1935 it consisted of approximately £250 from sales of agricultural produce and a grant of £400 from the Empire Cotton Growing Corporation for cotton experiments at Mazabuka. The costs of the latter have been included in the table of expenditure, thus the net cost of the department was less than £5,000.

77. The Empire Cotton Growing Corporation has seconded one of its officers to the Territory since 1929 and, during the last two years, has borne the entire cost of cotton experiments at Mazabuka. This assistance, which was forthcoming at a time when it was most urgently needed, is acknowledged with gratitude.

LEGISLATION.

78. The Maize Control Ordinance was passed at the end of the year and will come into force on May 1st, 1936. The Ordinance authorises the appointment of a Control Board in which all maize produced for sale within a scheduled area will be vested. The Board will dispose of maize at a controlled price within the scheduled area and will export the balance, after making such provision for the following season as it may deem necessary. The net proceeds of sales will be divided, pro rata, among those who surrendered maize to the Board. The scheduled area is a belt on either side of the railway line which includes the principal producing and consuming centres.

79. The Importation of Plants (Amendment) Regulations, 1935, were published in January. The object of these regulations is to permit the transit by rail of plants and seeds (except cotton) through the Territory, from one scheduled state to another, without formality.

80. The Importation of Plants (Amendment) (No. 2) Regulations, published in October, authorise the use of the uniform certificate of health which has been adopted by all Dominion and Colonial Governments.

PART II.—FORESTRY.

INTRODUCTION.

81. Before proceeding to review Forestry operations in 1935 it is desirable to place on record the unique and, in the main, quite unavoidable difficulties under which the department has to work. From its inception in 1928, these difficulties have severely handicapped the department in its primary task of conserving the forest resources of the Territory, yet they have never yet been formulated in departmental reports, and some misunderstanding has arisen from this omission.

Sharing of Royalties.

82. The first of the difficulties lies in the fact that under the agreement made with the British South Africa Company in 1923 the Government of Northern Rhodesia is obliged to divide its revenue from land sales in North-Western Rhodesia equally with the Company, after making a deduction for cost of management and collection. Later it was ruled that timber royalties from Crown Forests were similarly divisible. This agreement does not expire until 1965. At the time of writing the cost of management and collection is assessed at 10 per cent. of the gross receipts, so that for every £100 obtained from timber sales from Crown Forests, the Government receives £55 and the Company £45.

83. Now it is an accepted principle that the replacement of the trees felled is a first charge on revenues derived from timber royalty. If this is not applied the forests immediately become a wasting asset. Replacement means not merely replanting, but tending the trees until they reach exploitable size. In a country like Northern Rhodesia where the growth is slow, where fire protection is an essential annual operation, and in which no very valuable species grow gregariously, the cost of replacement will absorb the *entire* royalties unless the rates are raised to a level which would practically prohibit the development of any industries dependent on cheap timber. Yet at present only 55 per cent. of the gross royalties accrue to Government.

84. The implications are obvious. While the present arrangement holds, either the forests must be regarded as a wasting asset or they must be replaced largely at the cost of the taxpayer. A solution would lie in the locking up of all forests until 1965, but this is clearly impossible if the development of the country is not to be arrested.

85. It has been represented that the present basis of assessment of " cost of management and collection " is unsatisfactory in its application to timber royalties, and the matter is at present under consideration.

Mining Rights.

86. The second difficulty lies in the indefeasable rights to timber on mining grants and concessions, which were granted to holders under the Mining Law of 1912. Large areas of some of the best forests in the Copper Belt are held under mining titles. In these forests cutting is not under departmental control, and follows no systematic plan. No funds for replacement are accruing, and when the leases of these mineral areas lapse, the Territory will be faced with the alternatives of costly regeneration or the loss of valuable forests over an area of some 500 square miles.

87. The mining grants for the most part lie on the geological formations which carry the best timber. They are also the most accessible areas to the present mines. Quite apart from the question of royalty it is clearly in the best interest of Mining Companies to secure a sustained yield of timber on these areas. The department can and, in fact, has offered advice to the Mining Companies on economical management of the timber on mining grants ; but it has neither the means nor the power to give effect to its injunctions.

Long Term Leases.

88. The third difficulty lies in the existence of long term leases in the large *Baikiaea* forests in the south of the Territory. The leases, which were granted before a forest department was in existence, were framed on most unsatisfactory lines. Not only were the rentals very low, but the absence of felling regulations has rendered rehabilitation unnecessarily expensive.

89. In these forests there are two further complications :

(*a*) Some of them are the property of the Barotse nation to which all revenues accrue. This difficulty will be surmounted in future leases by the formation of a fund for forest management from part of the revenues received.

(*b*) The remoteness and nature of the forests render costs of extraction high. Moreover the capital charges on a logging railway 100 miles long necessitate a high annual output, higher in fact than the annual increment of the forests. Thus they cannot be exploited economically on orthodox rotation principles. The whole group of forests must be cut over heavily and then allowed a long unproductive period for regeneration, during which time rigorous fire protection is essential. If follows that sufficient funds must be obtained from the first exploitation to finance forest operations during the very lengthy non-productive period—a period which may very well exceed ninety years.

90. The formation of a forest fund from revenues derived from future leases will secure the future of the unexploited forests. Those which have already been exploited (*i.e.*, 180 square miles of gregarious *Baikiaea*) must be written off or become a liability on the taxpayer for a considerable period.

91. Finally the low market value of the produce and the high costs of extraction make it impossible to charge an adequate royalty. If the forests are to be exploited at all, a compromise between an adequate and an entirely insufficient royalty must be reached. This will involve the abandonment of the inferior forests after exploitation, in order to devote the available funds to those most worthy of preservation.

92. It has been suggested that the prices of timber will rise and that the unexploited forests should be locked up until they can bear royalty at an economic rate. Government may yet have to take this advice even though it would mean the closing down of the largest non-mining industry in the Territory, and the protection of the forests in the interim.

The Effect of Inherited Liabilities.

93. The combined effect of these three factors is that although the present volume of timber cut for sawing in Northern Rhodesia exceeds that of the entire group of East African colonies, and although there is a large internal and export trade, yet the minute department cannot pay its way and the conveniently situated forest resources of the Territory are being wasted at an alarming rate.

ESTABLISHMENT AND ORGANISATION.

94. The year under review has in some ways been the most difficult and disappointing in the history of the department. Steady progress has been made in the *Baikiaea* forests but elsewhere there has been retrogression. For four months of the year no forest officer was available for the remainder of the Territory, and for a further six months only one was available.

Concurrently with this shortage of staff there was a very large, and in the circumstances, rather unwelcome increase in the consumption of local timber on the Copper Belt.

95. The European staff was posted as follows :

J. D. Martin, Assistant Conservator : Southern Division—January till December.

C. E. Duff, Assistant Conservator : On leave—January till June ; Northern Division—June till December.

R. G. Miller, Assistant Conservator : Central and Northern Divisions—January ; Seconded to New Capital—February till July ; On leave—August till December.

G. R. Martyn, Forester (new appointment) : Southern Division—July till December.

96. The native staff consisted of fourteen Forest Guards in the Southern, three in the Central and three in the Northern Divisions.

97. It has now been found necessary to combine the Northern and Central Divisions and to extend the Southern Division to the Kafue, though in this latter Division it is impossible to do much outside the *Baikiaea* forests which lie in the Livingstone and Sesheke districts.

98. It is a great pleasure to record the valuable assistance given by Mr. J. B. Clements, Conservator of Forests, Nyasaland, who was seconded in June for a period of three months to advise Government on forest policy. Mr. Clements was sympathetically appreciative of the unique difficulties under which the department is working, and it is a source of much gratification and reassurance to me, a layman, that his reports completely endorse the programme, operative and projected, at the time of his visit. For this satisfactory feature of an otherwise depressing situation the three Assistant Conservators must be given full credit. Each has shown initiative and sound judgment in the absence of technical direction.

DEMARCATION OF FOREST RESERVES.

99. Two areas in the neighbourhood of Lusaka were gazetted as Demarcated Forests. These are :

Lusaka East Reserve.—An area of low hills some 4,700 acres in extent, forming the source of the Chalimbana River. These hills have a fairly dense cover of *Isoberlinia* and *Brachystegia* species and under dispersed working should yield good supplies of firewood. The reserve, however, is to be managed primarily as a protection forest.

Lusaka Native Fuel Reserve.—A well wooded farm of 1,200 acres lying on the outskirts of Lusaka township. This reserve is intended as a source of cheap firewood for the native inhabitants of the north-western suburb, who were suffering from shortage of adequate supplies.

OPERATIONS SOUTH OF THE KAFUE.

100. In this area work was confined to the Livingstone and Sesheke districts and was devoted principally to the reconnaissance and protection of the *Baikiaea plurijuga* (Mukushi) forests of the Kalahari sands, and to the supervision of their exploitation.

Reconnaissance : Livingstone District.

101. A survey of the boundaries of 25 square miles of unexploited forest was carried out and demarcation was begun. A preliminary reconnaissance of a further 20 square miles of forest was also completed and forest boundaries and the adjoining vegetation were mapped. A short tour was undertaken to fill in doubtful areas in the vegetation map of the district.

Reconnaissance : Sesheke District.

102. Extensive preliminary reconnaissance of the unexploited forests of the Sesheke district was undertaken single handed by Mr. Martin. Over 2,000 miles was toured on foot and 1,300 miles of compass and cyclometer traverses were made. A vegetation map of 3,000 square miles of country was prepared. The portion of the lower Sesheke district which was traversed was virtually unknown territory and figured on former maps as " Uninhabited Forest ". Mr. Martin's survey has now been accepted by the Survey Department and has enabled what was formerly one of the largest " blanks " in the map of Northern Rhodesia to be filled in.

The Zambesi-Mashi Watershed (Lower Sesheke District).

103. This area is bounded by the Zambesi River, the Kaprivi Strip, the Mashi River and the Senanga district boundary. About 30 per cent. of the country is forested with *Baikiaea*, but with the exception of a belt of small forests of the " Mutemwa " type adjoining the Zambesi and Mashi Rivers, the stocking of *Baikiaea* is too low to permit of exploitation. The non-mutemwa type forests consist mainly of *Baikiaea* woodland in which the stocking of exploitable trees is only three to four per acre. In addition, the country is almost waterless in the dry season.

104. The following are the principle types of forest in the area. Unless otherwise stated they are found on the sand :

(*a*) Mutemwa (forest with dense climbing undergrowth) :

1. *Baikiaea plurijuga-Pterocarpus angolensis* forest.
2. *Baikiaea plurijuga-Commiphora* forest.
3. *Baikiaea plurijuga-Acacia giraffae* forest.

(*b*) Woodland :

1. *Baikiaea plurijuga*-bushy undergrowth.
2. *Baikiaea plurijuga-Pterocarpus angolensis-Copaifera coleosperma* woodland, with or without *Ricinodendron rautanenii*.
3. *Pterocarpus angolensis-Copaifera coleosperma* woodland, with or without *Ricinodendron rautanenii*.
4. *Dialium angolense-Burkea africana* woodland.
5. *Parinarium mobola-Burkea africana* woodland, with *Dialium angolense* and *Isoberlinia paniculata*.
6. *Isoberlinia paniculata* woodland.
7. *Copaifera mopani* woodland. (On hard soil.)
8. *Burkea africana* woodland. (On loose sand.)

(*c*) Bush Group or Semi-Plain Type :

1. *Burkea africana*-long grass. (On hard soil.)
2. *Acacia giraffae*-long grass. (On hard soil.)
3. *Diplorrhyncus mossambicensis-Burkea africana-Erythrophloeum africanum-Amblygonocarpus obtusangulus*. (On hard soil.)

(*d*) Watershed Plain, with or without groups of *Burkea africana* on fine loose sand.

105. It had been hoped that reconnaissance of this area would reveal a vast extension of the exploitable *Baikiaea* forests. This hope has not been realised, but the reconnaissance is nevertheless of first importance in indicating the limit of the Territory's resources of *Baikiaea*.

Upper Sesheke District.

106. This area contains probably the only economically exploitable *Baikiaea* forests in Barotseland. A preliminary enumeration survey of part of the area, carried out by the Zambesi Saw Mills Limited gives a volume of approximately ten million cubic feet of exploitable timber adjoining the Machili and Njoko Rivers. The Assistant Conservator did a preliminary reconnaissance of part of these forests and of the much larger forests in the Simungoma and Katongo areas adjoining the Zambesi. The boundaries of these forests and the adjoining vegetation were mapped, but it is not yet possible to give an estimate of the total volume of exploitable timber available. The preliminary reconnaissance of the Sesheke district will be completed in 1936.

Fire Protection.

107. Grass growth in the unexploited forests was sparse and fire danger less than usual. In the Livingstone District 190 square miles of forests (130 exploited and 60 unexploited) were protected by external and internal fireguards, an increase of 30 square miles on the area protected in 1934. In addition, 150 square miles of unexploited forest in Sesheke district were protected for the first time by external fire-breaks. Tax labour was used for all the work and, owing to the uncertainty of supply, it was not possible to put fire-protection on a permanent basis, that is, to cut proper internal and external fire-breaks.

108. The Livingstone district forests were patrolled by Forest Guards throughout the dry season. Five outbreaks of fires occurred in protected areas ; three of these were extinguished by Forest Guards and local natives, and the others by the departmental labourers, before much damage was done.

109. In the Sesheke district a large fire on a twelve mile front swept up to the Simungoma forest before the external boundary line was completed. After three days of fighting it was put out by Forest Guards, labourers and the local population. The damage was slight. In this district the forest indunas proved of great assistance in preventing fires and organising fire-fighting gangs.

110. A striking illustration of the destruction caused by fires in the past was seen in the Simungoma forest. A large area which old natives remember to have been good *Baikiaea* forest is now devoid of tree growth and covered with a dense mass of *Acacia-Dichrostachys* scrub, only charred stumps remaining as evidence that it was once *Baikiaea* forest.

Forest Protection by Native Authorities.

111. The *Baikiaea* forests in the Sesheke district are of considerable value. They cover, collectively, an area of 250 square miles and are likely to be exploited in the near future. In the past they have been allowed to deteriorate through fires and indiscriminate felling. A rudimentary native forest law existed but it was not rigidly enforced, yet, as in other parts of Barotseland the native authority is a particularly powerful one. The three factors, valuable forests, a distinct if insufficiently developed forest sense and a strong native authority combine to make the area a particularly promising one for the initiation of a forest service as a part of the native administration.

112. This unique opportunity was quickly realised by the Assistant Conservator and, in conjunction with the District Commissioner, a scheme of forest protection by the native authority was drawn up early in the year and put into operation a few months later.

113. Briefly the system is one of division of the forest areas of the district into ranges. A resident induna or councillor has been appointed forest induna of each range and is responsible for the observance of the native forest law in that range and for the prevention of fires and other forest offences. He is also responsible for fire fighting. A senior induna has been appointed head forest induna in charge of all the forest indunas. The forest indunas are paid a small monthly wage by Government and have power to try forest offences. From the start the scheme has worked very satisfactorily. Also several amendments and additions to the existing native forest law were recommended to the native authority and accepted by it.

114. The scheme was by no means as simple to initiate as might be inferred from the preceding paragraphs where, for the sake of clarity, the term " native authority " has been used in the singular. Actually in this district there is a very complicated system of control by two distinct native authorities. I consider that Mr. Howe (the District Commissioner) and Mr. Martin deserve great credit for successfully welding a single forest service from the dual authorities and thereby initiating what seems likely to become a model for native administrations in other parts of the Territory.

115. In the Livingstone District in which there are five native authorities, each controlling a *separate* area, a council of chiefs was convened by the District Commissioner. An appropriate native forest law, prepared by Mr. Martin, was submitted to and accepted by this council.

Shifting Cultivation.

116. The prohibition by the Paramount Chief of shifting cultivation in the *Baikiaea* forests of Barotseland was rigidly enforced in the Sesheke district by the native authorities. The Assistant Conservator was invited by the native authorities to visit the Simungoma area where there was alleged to be a shortage of land suitable for cultivation outside the *Baikiaea* forests. The position was investigated with representatives of the native authorities and no immediate shortage was found.

117. Shifting cultivation in conjunction with regeneration by the Taungya system was permitted in the forests at Katombora (Livingstone district). Approximately 20 acres were sown.

Silviculture and Regeneration.

118. No further experimental work was undertaken owing to the continual absence of the staff on fire-protection and reconnaissance. The establishment of *Baikiaea* by spot sowing with native field crops (Taungya) was a marked success at Bombwe ; 60 per cent. survival was obtained and a good crop of millet was reaped. At Katombora the Taungya was a partial failure owing to the low rainfall after sowing. The native crops also failed in this area.

119. Toward the end of the year an additional area of 16 acres was sown at Katombora under this system and at Bombwe a further crop of millet was sown between the lines of *Baikiaea*. Many natives, including representatives of the native authorities of the Sesheke district, visited the Taungya area at Bombwe and the method was explained to them. Two headmen whose villages are situated near Bombwe elected to return to the forest to cultivate under this system. Several modifications which they suggested have been adopted to ensure the smoother working of the scheme.

120. Fire-protection of forests before exploitation is done to secure abundant natural regeneration while there are still plenty of seed-bearers on the area. In this it has proved successful. Good regeneration was obtained before exploitation and, although large numbers of seedlings were destroyed during felling and extraction, the number surviving was sufficient to justify the method.

121. The year was not a seed year in the *Baikiaea* forests. A heavy crop of Mungongo (*Ricinodendron rautanenii*) fruit was produced, however, and this formed the staple diet of the natives at Katombora and in parts of the Sesheke district where the field crops had failed.

122. The trial plots of indigenous and exotic species, laid out on the Kalahari sand ridge near Livingstone, were disappointing owing to the failure of the rains shortly after planting. The plots are being continued, transplants being raised in the municipal nursery.

123. Mazabuka experimental plantation, which was started in 1930 to investigate the possibilities of utilising abandoned maize lands in the farming belt, was weeded and protected from fire. *Cedrela toona* and *Cassia siamea* gave three year old stands 20 ft. high, and *Maesopsis eminii* of the same age averaged 12 ft. Other species which grew rapidly under the adverse conditions were *Trema guineensis*, *Acacia albida* (indigenous), *Trichilia emetica* (indigenous) and *Aleurites montana*. A very small plot of *Pinus caribaea* grew vigorously and was the only one of the coniferous species to show promise.

OPERATIONS NORTH OF THE KAFUE.

(Lusaka, Broken Hill and the Copper Belt.)

124. Here little progress can be reported. From February until June no European officer was available, and for the remainder of the year one officer had to manage the forest affairs in this vast area as best he could. No important reconnaissance could be undertaken and no new utilisation or silvicultural experiments were initiated. Urgent demands for small timber concessions, of which there have been an increasing number, were dealt with in the only way possible—by a brief inspection followed by the issue of " special licences " in which forest was sold by area instead of by measured volume. The negotiation of the terms of these special licences, and occasional inspections of the cutting areas, occupied much of the limited time of the staff. It should be added that as a result, the total sum collected in timber royalties in 1935, although not large, was nearly double that collected in 1934 and more than double that collected in 1933.

Management of Forest Reserves : Lusaka South Fuel Reserve.

125. The northern and several internal boundary lines of this reserve were defined, and the wood felled in clearing them was sold profitably. The yield on a felling area of 280 acres was assessed from a series of clear-felled sample strips, and the " coupe ", after division into twelve blocks, was sold standing to contractors and subsequently clear felled by them. Fire guards were hoed round the 1934 and 1935 " coupes " and along the northern boundary, and early burning was carried out sporadically in the remainder of the reserve. Free issues of poles, firewood and building materials for the ceremonial opening of the New Capital and to Government departments were made in considerable quantities.

Lusaka East and Lusaka Native Fuel Reserves.

126. As soon as they had been gazetted, the boundaries of these two reserves were defined on the ground. In all, 18 miles of boundary line were cleared. The two reserves were then closed to all cutting and were effectively patrolled by resident forest guards.

Lenje Native Forest Reserve.

127. This is a well wooded area in the south of the Lenje Native Reserve and close to Lusaka which is being managed departmentally. Operations are financed by, and all profits accrue to the Native Reserve Fund. During the year temporary buildings were erected and double-line fire guards were surveyed and cut round the block which is under exploitation. By early burning between these lines, the felled areas were successfully protected from fire throughout the year. Cutting was carried out in groups and strips over an area of some 300 acres. Only native inhabitants of the reserve were employed. In August the year's yield was reached and cutting was then stopped. The total profits earned for the reserve fund during two years' working exceeded £200.

Ndola West Reserve.

128. Short lengths of several of the boundaries were cleared. Fire guards were maintained round the plantation and other experimental areas ; in the rest of the reserve extensive early burning was carried out. Very little wood was sold from this reserve.

Chondwe Forest.

129. The boundaries remained undefined. Early burning was attempted but met with indifferent success owing to the variable nature of the undergrowth, where extensive stretches of herbs and bracken did not dry out simultaneously with the areas of grass.

Experiments in Silviculture and Utilisation : Natural Regeneration.

130. Under permanent sample plots in dense *Isoberlinia* woodland at Ndola, the growth of staked seedlings and the development of ground cover after two years of fire protection was notably superior to that in plots subjected to annual burning, even where burning was carried out early in the season. In the series of one-acre plots laid out in 1933 to study the resistance of coppice regrowth to fire, the contrast between plots burned early and those burned late in each season is now most pronounced.

Artificial Regeneration.

131. In the season 1934-35 only a part of the programme at Ndola was carried out owing to the shortage of staff. The normal programme was resumed at the end of the year. Small plots of the following pines were replanted : *Pinus longifolia, P. radiata, P. pinea, P. canariensis, P. pinaster, P. halepensis, P. palustris, P. arizonica, P. caribaea, P. taeda, P. excelsa, P. muricata, P. ponderosa.* Transplants were not vigorous, and with open rooted planting there were many losses. Indigenous species gave better results. 1933 sowings of *Afzelia quanzensis, Albizzia gummifera* and *Entandrophragma caudatum* grew excellently.

132. New experimental sowings were made both in prepared ground and in rough lines cleared through the bush, with each of the following indigenous species : *Afzelia quanzensis* (Mupapa), *Afrormosia angolensis* (Mubanga), *Albizzia antunesiana* (Musase), *Albizzia gummifera* (Mutanga), *Entandrophragma caudatum* (Mofu), *Erythrophloeum africanum* (Kayimbe, Mukoso), *Pterocarpus angolensis* (Mulombwa, Mukwa), *Isoberlinia tomentosa* (Mutobo), *Khaya nyasica* (Mululu, Mbawa). Cover crops of *Tephrosia vogelii* were established on certain plots.

133. At the end of the year the first attempts were made at using clay planting pots of the type used in Nyasaland. These increased the cost of transplants by more than 10 per cent. but proved better than the former method of using open rooted transplants, especially when planting was done with raw labour.

134. A small plantation of 14 species of *Pinus*, established in 1934 near Mwinilunga in the high rainfall area on the Angola frontier, was well tended under the kind supervision of a local landowner, Captain K. R. Paterson. Twelve new plots of different species of *Pinus* were planted. Nursery losses from " damping off " were very heavy.

Utilisation.

135. An air seasoning experiment with nearly 200 planks (8 ft. by 12 ins. by 2 ins.) of ten indigenous species had to be abandoned owing to lack of staff.

136. A combined preservation test and durability trial with 26 native and three imported timbers was inspected and the results recorded in an interim report. After two years in the ground the naturally perishable species impregnated with five per cent. copper sulphate or five per cent. zinc chloride had begun to lose their immunity to termite attack, many of them being badly eaten. All samples treated with salts of arsenic remained intact. The following species proved to be naturally resistant to termites without treatment : *Afrormosia angolensis* (Mubanga), *Baikiaea plurijuga* (Mukushi), *Albizzia antunesiana* (Musase), *Erythrophloeum africanum* (Kayimbe), *Pterocarpus angolensis* (Mukwa), and *Entandrophragma caudatum* (Mofu).

SEEDS, PLANTS AND ADVISORY WORK.

137. Mr. Miller was seconded from February until June for tree planting at the New Capital.

138. Little seed and scarcely any plants were sold or given to the public during the year. It was impossible to continue this service owing to the pressure of more important work. For the same reason little assistance was given to private persons with tree planting, except in the neighbourhood of Lusaka.

139. The department, however, worked in co-operation with the Ndola Municipality in establishing a *Eucalyptus* plantation as an anti-malarial measure on seepage zones of the Itawa Swamp. Transplants of *Eucalyptus rostrata*, *E. maideni*, *E. robusta* and *E. teretricornis* were raised specially for the work and supplied to the Municipality free of charge. The mounding and planting of 15 acres of swamp was supervised. By the end of the year a satisfactory planting technique had been evolved, and arrangements were made to hand the whole of the work over to the Municipality as a going concern.

140. At Livingstone also, the Municipal nursery was supervised by the Assistant Conservator of Forests and a plan of street planting was drawn up for the Municipality.

141. Information on handling and preserving native timbers was given to the Copper Mines, and Mr. Duff co-operated with the staff of the Roan Antelope Mine in utilization trials. In addition, each of the mines was supplied with draft felling rules for application in the extensive *Isoberlinia* forests under their control.

FOREST INDUSTRIES AND EXPLOITATION.

Milling.

142. The Zambesi Saw Mills Ltd., worked at full capacity throughout the year, employing 100 Europeans and 3,800 natives in the mills and forests. 2,826,000 cubic feet of timber in the round were extracted from Yeta's forests and 82,000 cubic feet were brought in from the Bechuanaland forests for milling in Livingstone. The actual sawn output was 1,005,400 cubic feet of timber, made up as follows :

Railway and Mine Sleepers	...	723,000 cubic feet.
Mining and other timber ...	...	276,900 cubic feet.
Parquet and other Flooring	...	5,500 cubic feet.

Activities in the Copperbelt.

143. The use of indigenous timber, especially in the Copper Mines, increased greatly and by the end of the year showed promise of considerable developments in the immediate future. It is estimated that the year's consumption, in the Copperbelt alone, exceeded a quarter of a million cubic feet of timber in the round.

144. Large supplies of sleepers of durable species (*Erythrophloeum*, *Afrormosia*, and *Faurea*), were cut on the mining grants controlled by Mufulira Mine. By the middle of the year supplies of these species on the Mufulira mining grants, including Chambishi, had been exhausted. A contractor then established a small plant at Ndola for treating sleepers with Arsenious Oxide by the open tank process, and proceeded to cut out some eight square miles of forest on Crown Land at Chondwe. Some of these sleepers were supplied to Nkana Mine, as well as to Mufulira. Sleepers of *Isoberlinia paniculata* and *Brachystegia utilis*, roughly adzed and untreated with preservatives, were taken by Nkana Mine from forest on the mine properties near Mindolo.

145. Nkana Mine used a considerable volume of timber in the form of 30 foot logs (which are plunged into the molten copper as part of the purifying process). Spurs were run from the railway into the forests on mine property, where the trees were felled, dragged to the railhead by tractor, and loaded on to bogies by derricks.

146. The Roan Mine felled and brought in 40,000 cubic feet of *Isoberlinia* wood from its concession, and when the supply of 8 inch to 12 inch poles was exhausted in this area, a cutting camp was established on Muliashi Grant to continue the supply of this class of material. Much of the timber was sawn roughly to a 3 inch by 9 inch dimension and, after impregnation with 5 per cent. Zinc Chloride, was used underground in platforms, packs, chutes, raises and generally as bratticing and lagging.

147. At the end of the year licence was granted to a Belgian contractor to fell the first of a series of 30,000 cubic foot " coupes " on the Congo border, to supply heavy mining poles to Kipushi Mine, which lies on the Belgian side of the frontier some 20 miles from Elisabethville and which offers a good market for this type of timber.

Furniture and Joinery.

148. The use of indigenous timber for furniture and joinery on the Copper Belt increased during the year as local builders and architects have gradually come to appreciate the decorative effects of Mukwa (*Pterocarpus angolensis*) and the durability of Kayimbe (*Erythrophloeum*). Five square miles of forest of good quality at Walamba were cut out to provide sufficient supplies of these timbers. By paying great attention to seasoning, the local saw mill at Ndola found it possible to lay in good stocks of other timbers of attractive appearance, such as *Terminalia rhodesica* (Chibobo), *Brachystegia hockii* (Muputu) in very large sizes, and *Isoberlinia tomentosa* (Mutobo), with losses on degrade so small that they would have been considered incredible three years ago. The introduction of the best of these common species as joinery timbers is a most important step forward. It is in no small degree the outcome of constant propaganda by Mr. Duff for better methods of sawing and seasoning native timbers.

Firewood.

149. With the completion of building at the New Capital, the exceptional demand for firewood at Lusaka fell to more normal proportions. Most of it was met from the clear cutting of certain freehold farms by private persons. Less than one-third was supplied from Forest Reserves. At Broken Hill the Mine, having exhausted the wood on the 30 square miles of its own holdings, applied for a 10 square mile concession of Crown Forest. As a temporary expedient, during the shortage of staff, it was granted licence on special terms to cut one square mile. Of this, over half had been clear felled for firewood by the end of the year. A new licence was issued for the clear felling of 340 acres at Misundu lime works in the Ndola district, where 6,000 cords of wood are consumed annually as fuel. Special conditions were attached to the licence requiring the licensee to protect from fire an area of 600 acres which had been clear felled by him during the last two years. The total cut of firewood on the Copper Belt for the year is estimated at 20,000 cords. Very little of this wood was cut on Crown Land, or under the control of the department.

EXPORTS AND IMPORTS.

150. The following tables show the value (in country of origin) of exports and imports of timber during recent years :

EXPORTS.

	1929	1930	1931	1932	1933	1934	1935
	£	£	£	£	£	£	£
Unmanufactured ...	6,202	4,077	4,236	9,674	11,634	20,903	
Partly manufactured ...	153	1,383	178	73	309	1,245	
Joinery	1,465	553	91	514	347	79	(9
Furniture	5,141	3,299	4,248	9,256	6,222	1,039	months
Other manufactures ...	3,475	14,113	26,993	3,858	4,538	1,351	only)
Railway sleepers	*	*	*	17,826	31,291	39,557	
Totals	16,436	23,425	35,746	41,201	54,341	64,174	68,696

*Included under " Other manufactures."

IMPORTS.

	1929	1930	1931	1932	1933	1934	1935
	£	£	£	£	£	£	£
Unmanufactured ...	62,328	98,183	58,502	29,293	29,264	41,294	
Partly manufactured	10,828	12,767	10,361	2,304	2,646	2,754	(9
Furniture	36,207	44,988	43,181	9,527	8,375	12,867	months
Joinery	31,538	33,562	27,277	4,232	1,867	4,202	only)
Other manufactures ...	11,950	18,927	12,464	6,137	5,940	10,632	
Totals	152,851	208,427	151,785	51,493	48,092	71,749	35,998

151. It will be seen that while exports are rising, there has been an appreciable decrease in the value of imports. This decrease is largely explained by the completion of construction programmes at the mines. The chief imported timber is Pitch Pine which is required principally for mine shafts. Former imports of Douglas Fir have, to some small extent, been replaced by indigenous timbers.

REVENUE AND EXPENDITURE.

152. Revenue and expenditure since the inception of the Forest Service is given in the following table :

Year.	*Gross Revenue.*	*Expenditure.**
	£	£
1928-29	2,458	641
1929-30	3,757	1,376
1930-31	850	1,854
1931-32	417	2,740
1932-33	423	2,997
1933 (9 months)	316	2,366
1934	693	2,298
1935 (estimated)	1,050	3,750

*The figures under Expenditure are exclusive of administration charges.

153. The earlier part of the table leads to the fortunately spurious conclusion that increased expenditure on forestry may be relied upon to decrease revenue. Actually the sudden fall in revenue in 1930-31 was caused by the exhaustion of Crown Forests by the Zambesi Saw Mills. The Company then moved into what are known as " Yeta's Forests " the revenues from which accrue to the Paramount Chief.

154. In 1935 no royalty was paid to Government on the 2,800,000 cubic feet of timber felled by the Zambesi Saw Mills, nor on the 200,000 cubic feet estimated to have been felled by the Copper Miner on their mining grants. Most of the firewood supplies came from private sources. In the circumstances the gross revenue figure is not unsatisfactory, but only 55 per cent. of this accrues to Government.

C. J. LEWIN,
Director of Agriculture.

MAZABUKA,
27th March, 1936.